Use of a Reclaimed Stripmine by Grassland Nesting Birds in East-Central Ohio[1]

DANNY J. INGOLD, Biology Department, Muskingum College, New Concord, OH 43762

ABSTRACT. **During the 1997-1998 breeding seasons the author examined the nesting success of grassland birds on plots that were mowed prior to the onset of nesting and on unmowed plots on a 3,700 ha reclaimed stripmine in east-central Ohio. Grasshopper sparrows (*Ammodramus savannarum*), eastern meadowlarks (*Sturnella magna*), red-winged blackbirds (*Agelaius phoeniceus*), Henslow's sparrows (*A. henslowii*), and bobolinks (*Dolichonyx oryzivorus*) were the most abundant nesting species on the reclaimed stripmine. No short-eared owl (*Asio flammeus*), Henslow's sparrow, bobolink, or mallard (*Anas platyrhynchos*) nests were located on the mowed plots. Significantly more nests of all species combined ($P < 0.05$) were found on the unmowed plots, and pairs using mowed plots tended to initiate nesting later in the season. A Mayfield analysis suggests that grasshopper sparrows had the greatest overall nesting success on the reclaimed plots (46%), followed by red-winged blackbirds (30%) and eastern meadowlarks (30%). During both years combined, nests on mowed plots suffered slightly higher predation rates (47%) than did nests on unmowed (39%) and control (38%) plots ($P > 0.05$). These data suggest that early season mowing is detrimental to some grassland bird species on this reclaimed stripmine since it precludes early nesting; however, it appears that Henslow's, savannah, and grasshopper sparrows, and other uncommon or sporadic grassland breeders in Ohio, are benefiting from this expansive, reclaimed surface mine.**

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INTRODUCTION

Surface mining for coal in the Appalachian region of the eastern United States has resulted in the transformation of thousands of hectares of natural areas to significantly altered ecosystems frequently dominated by exotic herbaceous and woody plant species (Whitmore and Hall 1978; Whitmore 1980; Wray and others 1982; Brenner 1984; Brenner and others 1984). These areas often lack the species diversity and ecosystem stability that existed prior to reclamation efforts (Wray and others 1982; Brenner 1985, 1990). Concomitant with the conversion of surface-mined areas in the eastern US from forests to grasslands has been a steady conversion of native tallgrass prairies and, to a lesser extent, hayfields and pastures to agricultural fields (Troutman and others 1979; Farris and Cole 1981; Bollinger and Gavin 1989; Hands and others 1989; Smith 1992; Herkert 1994a). This in turn has led to the steady decline of several grassland bird species in the central and eastern US (Robbins and others 1986; Herkert 1991, 1994a, 1997; Knopf 1994; Swanson 1996; Helzer and Jelinski 1999; Bajema and others 2001). For example, populations of grasshopper sparrows (*Ammodramus savannarum*), eastern meadowlarks (*Sturnella magna*), Henslow's sparrows (*A. henslowii*), and bobolinks (*Dolichonyx oryzivorus*) have declined by as much as 84%, 74%, 70%, and 59%, respectively, from 1966 through 1991 in Ohio (Swanson 1996). Thus, although reclaimed stripmines are artificial ecosystems, they provide a potential refuge for a variety of grassland birds whose populations are declining and might not otherwise be able to survive in the area (see Whitmore and Hall 1978; Whitmore 1980, 1981; Anderson and others 1994; Swanson 1996; Bajema and others 2001). Although populations of grasshopper and Henslow's sparrows have declined steadily in the glaciated portions of Ohio, their numbers have increased in the southeastern, unglaciated counties where nesting habitat has become increasingly common during the past 25 years on reclaimed stripmines (Peterjohn 1989; Peterjohn and Rice 1991). Eastern meadowlark populations in Ohio are most robust on reclaimed stripmines in the southeastern portion of the state (Peterjohn and Rice 1991). Bobolinks are not as common in southeastern Ohio, but they frequently use reclaimed surface mines for nesting (Whitmore and Hall 1978; Peterjohn 1989; Peterjohn and Rice 1991).

If islands of reclaimed land are going to provide suitable nesting habitat that will help to maintain sustainable populations of grassland birds, the size of such tracts, as well as a variety of extrinsic factors that influence grassland habitat structure (for example, mowing, haycropping, burning, and grazing) should be considered. The size of a grassland tract has been shown to play a key role in determining which bird species are able to establish breeding populations in a given area (Herkert 1991; Herkert and others 1993; Vickery and others 1994; Bollinger 1995; Swanson 1996; Helzer and Jelinski 1999; Walk and Warner 1999; Bajema and others 2001). Unlike most of the unmined land in southeastern Ohio (most of which is farmland), large portions of reclaimed stripmines in this region are ungrazed, unburned, and unmowed, and ostensibly provide suitable nesting habitat for a variety of grassland birds including those species that are sensitive to habitat fragmentation (for example, Henslow's sparrow; see Swanson 1996). Such sites should

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also provide a good arena to study the effects of mowing and hay-cropping on the reproductive success of grassland birds. Numerous studies have demonstrated that mowing and hay-cropping have had adverse affects on the breeding success of a variety of grassland bird species in the midwestern and northeastern US, particularly when the mowing and hay-cropping were done between May and August (Baskett and others 1980; Bollinger 1988; Frawley 1989; Sample 1989; Warner and Etter 1989; Bollinger and others 1990; Frawley and Best 1991; Herkert 1994a,b; Swanson 1996). Few researchers, however, have examined the effects of spring mowing (prior to 1 May) and fall mowing (after 1 August) on habitat use of grassland birds and recruitment of species to grasslands (but, see Herkert 1994a,b). Surprisingly few studies have focused on the reproductive success of grassland birds on reclaimed stripmines versus comparable unmined pasture or farmland.

My objectives in this study were to: 1) examine and compare the habitat use, nesting density and reproductive success of grassland-nesting birds on a reclaimed stripmine compared to nearby unmined plots, and 2) test the effects of spring mowing (prior to 1 May) on the differential use of reclaimed grasslands by these birds. Since the grasslands on the reclaimed mine are more contiguous and expansive, I hypothesized that grassland bird diversity would be greater in this area than on the unmined plots, and that grassland birds would be more abundant and initiate nesting earlier on the reclaimed plots that had not been mowed prior to the on nesting compared to mowed plots.

STUDY AREA

This study was conducted from early May through late July 1997-1998 at the Wilds (International Center for the Preservation of Wild Animals), a 3,700 ha reclaimed stripmine at the intersection of Muskingum, Guernsey, and Noble counties in southeastern Ohio. In addition, data were collected on five unmined pastures (control sites) situated approximately 25 km north of the Wilds. The Wilds was initially stripmined by the Ohio Power Coal Company in the 1940s and 1950s. After a 10- to 15-year hiatus, the land was again mined from 1969-1984 and subsequently converted to mostly hilly grasslands with scattered wood lots, drainage ponds and lakes, and a large wetland area. The dominant grasses and herbs on the Wilds include fescue (*Festuca* spp.), orchard grass (*Dactyli glomerata*), timothy grass (*Phelum pratense*), rye grass (*Lolium* spp.), brome grass (*Bromus inermis*), Kentucky blue grass (*Poa pratensis*), redtop (*Agrostis gigantea*) yellow sweet clover (*Melilotus officinalis*), and birdsfoot trefoil (*Lotus corniculatus*). The dominant shrubs and woody species included Lespedeza (*Lespedeza serecia*), autumn olive (*Elaeagnus multiflora*), black locusts (*Robinia pseudoacacia*) and pines (*Pinus* spp.).

Plant species composition on the control sites overlapped to some degree with the Wilds study site. Two of the 5 control sites in 1997 and 3 of the 5 control sites in 1998 were located in hay fields dominated by orchard grass, timothy grass, rye grass, brome grass, fescue, blue grass, red clover (*Trifolium repens*), and alfalfa (*Medicago sativa*). The remaining control sites during both years were situated in unmanaged pastures (not mowed or grazed) characterized by a variety of herbaceous dicots including goldenrod (*Solidago* spp.), ironweed (*Vernonia* spp.), mint species, Indian hemp (*Apocynum cannabinum*), and blackberry (*Rubus allegheniensis*), as well as orchard grass, fescue, timothy, and blue grass. One of the control sites in 1997 was a low-lying, unmanaged pasture with some standing water. This plot was dominated by sedges (*Carex* spp.), goldenrod, Indian hemp, blackberry, poison ivy (*Rhus radicans*), blue grass, and a patch of cattails (*Typha* spp.). Because this plot was somewhat unique in its species composition, it was replaced with a hay field in the 1998 study.

METHODS

Data were collected on fifteen 210 × 90 m randomly-chosen, rectangular plots (1.9 ha; 10 on the Wilds and 5 control sites). All 10 mined plots were bordered on at least three sides by more than 50 ha of additional contiguous grasslands with some scattered autumn olive trees. The amount of contiguous grassland surrounding the control plots ranged from 4.0 ha to approximately 20 ha, and was frequently bordered by forests and woodlands on more than one side. Five of the reclaimed mined plots (the same each year) were bush-hogged and the cut vegetation was left lying in the plots during mid-April of both years. The remaining five Wilds plots were left uncut during both years. Both hay field control sites in 1997 and all three hay field control sites in 1998 were cut and raked for hay in late May or early June.

We actively searched for nests four to five days each week. Most nests were located by dragging rope (see Higgins and others 1969), although additional nests were found by randomly flushing birds from nests while walking or by following adults feeding nestlings. Each nest was marked with a flag 2.0 m north of the nest, and all nests were checked once or twice weekly.

The reproductive success for each bird species was calculated using the Mayfield method (Mayfield 1961, 1975). A nest was considered active if at least one egg was present, and a nesting effort was considered successful if at least one nestling fledged. Since the nestlings of many ground-nesting, grassland birds leave the nest before they are capable of flying, I considered them to have fledged if they remained in the nest at least 8-10 days (see Wheelright and Rising 1993; Vickery 1996), and there were no signs of predation. A nest was considered lost to a predator if the eggs were removed or broken, or if the nest was disturbed and the nestlings disappeared from the nest during their first week. I considered a nest abandoned if I detected no activity during three consecutive visits, or if the eggs were cold or the nestlings were found dead in the nest (see Kershner and Bollinger 1996).

I conducted strip transect censuses (see Emlen 1977; Conner and Dickson 1980) between 0600 and 1030 on each of the 15 plots once a week throughout the study (14 transect days in 1997 and 13 transect days in 1998). In order to avoid the potential for observer bias, I was

the only person to collect transect data. Transect lengths were 210 m; transect widths were 45 m on each side of the transect line on all plots. All birds that were seen or heard within the transect boundaries, as well as birds that flew into or out of the transect plot during the census, were counted. Birds that flew over the plot without landing were not counted. Overall relative abundance, pooled from all plots, was calculated using the transect data for each bird species; additionally, bird abundances for each species at the Wilds were determined for mowed and unmowed plots.

I used *t*-tests to test for differences in the numbers of each bird species on mowed versus unmowed plots; however, in some instances in which the data were not normally distributed, I used Mann-Whitney Rank Sum Tests. Since my nest sample size for most species on the Wilds was rather small, I combined the total number of nests for all species in each year and used Chi-square tests to examine whether there were differences in the total number of nests on mowed versus unmowed plots. I used a contingency table Chi-square test to compare the number of nest starts for all species combined before 1 June in each year (an arbitrary date by which most grassland bird pairs had initiated their first clutch) on mowed versus unmowed plots and to the number of nests initiated after 1 June. I examined whether there were differences in the number of nests lost to predators on mowed compared to unmowed and control plots during both years using contingency table Chi-square tests. All statistical analyses were performed with Sigma Stat (version 2.03 on a PC computer).

RESULTS

Species Abundance

Grasshopper sparrows, Henslow's sparrows, eastern meadowlarks, red-winged blackbirds (*Agelaius phoeniceus*), and bobolinks were the most abundant species on the Wilds during both 1997 and 1998 (Fig. 1). Savannah sparrows (*Passerculus sandwichensis*) and short-eared owls (*Asio flammeus*) were found exclusively on the reclaimed plots. Red-winged blackbirds, song sparrows (*Melospiza melodia*), eastern Meadowlarks, European starlings (*Sturnus vulgaris*) and Field Sparrows (*Spizella pusilla*) were generally the most abundant species on the control plots during both years, although Henslow's sparrows and bobolinks were prominent in 1998 (Fig. 2). Significantly more Henslow's sparrows were detected along transects in unmowed plots than on mowed plots during each year (Mann-Whitney Rank Sum Test; 1997, U = 17.5; df = 8; $P = 0.03$; 1998, U = 10; df = 6; $P = 0.028$) (Fig. 3). Short-eared owls were significantly more abundant along transects in the unmowed plots in 1998 ($t = 3.29$; df = 6; $P = 0.02$). No significant differences were detected in the numbers of any of the other species on the mowed versus unmowed plots during either year.

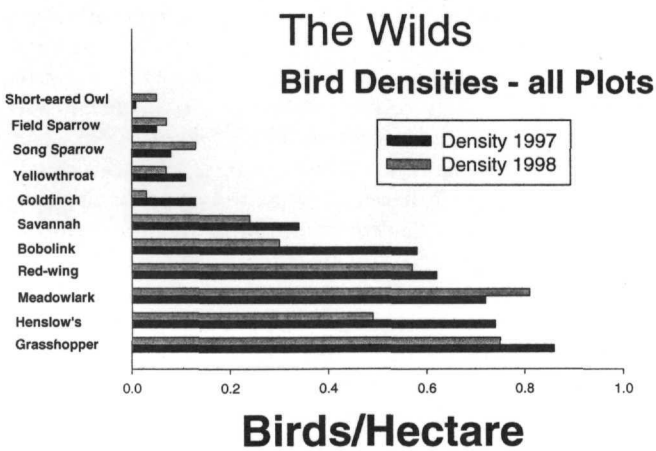

FIGURE 1. Mean densities of grassland birds on a reclaimed stripmine based on 14 strip-transect censuses done on each of 10 plots in 1997 and 13 censuses on each of 10 plots in 1998.

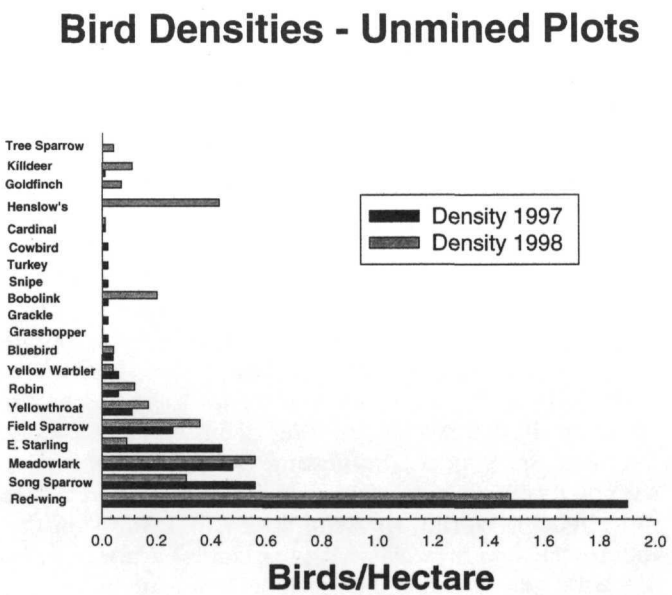

FIGURE 2. Mean densities of grassland birds on control (unmined) plots based on 14 strip-transect censuses done on each of 5 plots in 1997 and 13 censuses on each of 5 plots in 1998.

Nest Densities

Nest densities of all species combined on unmowed plots were greater than on mowed plots in both 1997 and 1998 (Fig 4.), and the total number of nests for all species was significantly greater on unmowed versus mowed plots during 1997 ($n = 29$; $X^2 = 4.96$, df = 1, $P < 0.05$), but not in 1998 ($n = 39$; $X^2 = 3.69$, df = 1, $P > 0.05$). The total number of nests for both years combined was significantly greater on the unmowed plots ($n = 68$; $X^2 = 9.19$, df = 1, $P < 0.01$). Nests of bobolinks, short-eared owls, Henslow's sparrows, and mallards (*Anas platyrhynchos*) were found only on the unmowed plots (Fig. 5). No significant differences were detected in the nest densities of red-winged blackbirds, eastern meadowlarks, savannah or grasshopper sparrows on mowed versus unmowed plots during either year ($P > 0.05$) (Fig. 5). Red-winged blackbirds had the greatest nest densities on the control plots during both years (Fig. 6), although the majority (75%) of red-winged nests were located on the wetland plot in 1997 (the plot that was replaced with a hayfield in 1998). The species composition of nesting birds on the control versus stripmined plots was markedly different (Figs. 5 and 6).

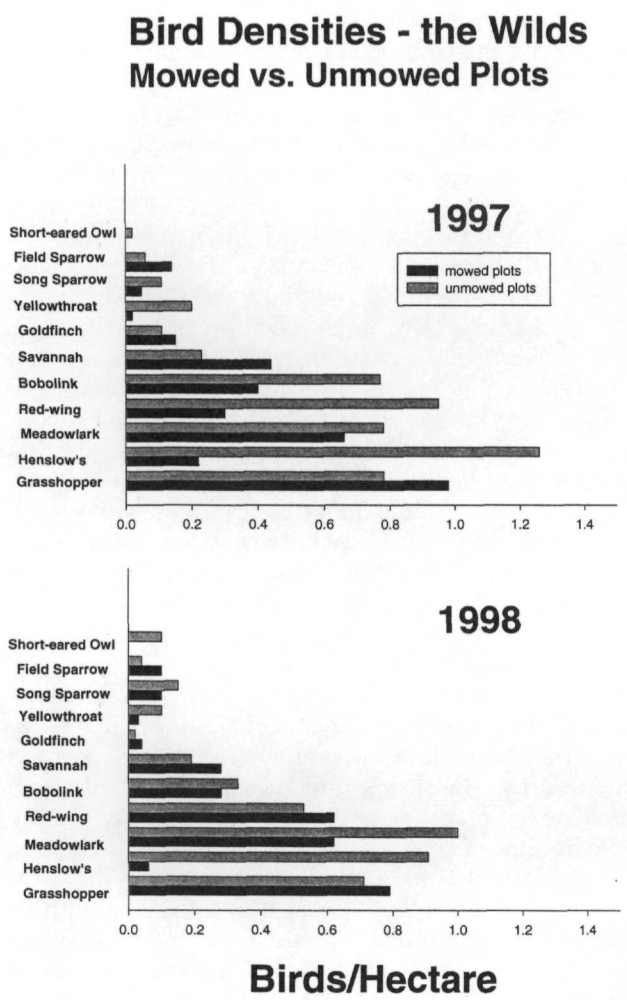

FIGURE 3. Mean densities of grassland birds on mowed and unmowed reclaimed stripmine plots based on 14 strip-transect censuses on each of 5 plots in 1997 and 13 strip-transect censuses on each of 5 plots in 1998.

Nest Predation

Nest predation accounted for 38% of nest failures on both mowed and unmowed plots in 1997 (3/8 and 8/21, respectively) and 46% (6/13) and 35% (9/26), respectively in 1998. I detected no difference in the predation rate on the mowed versus unmowed and control plots during either year or during both years combined. Mayfield analyses revealed that nest success on all the stripmined plots when both years were combined ranged from 30% for red-winged blackbirds and eastern meadowlarks, to 93% for bobolinks (Table 1; sample sizes were too small to compare mowed versus unmowed plots). Nest predation accounted for 35% (9/26) and 45% (5/11) of nest failures on the control plots during 1997 and 1998, respectively. Nest success ranged from 32% for song sparrows to 36% for American robins (*Turdus migratorius*) when both years were combined (Table 1).

Timing of Nesting

The number of nests of all species initiated on unmowed plots before versus after 1 June 1997 (11 before, 10 after) was significantly greater than the number of nests initiated on mowed plots before

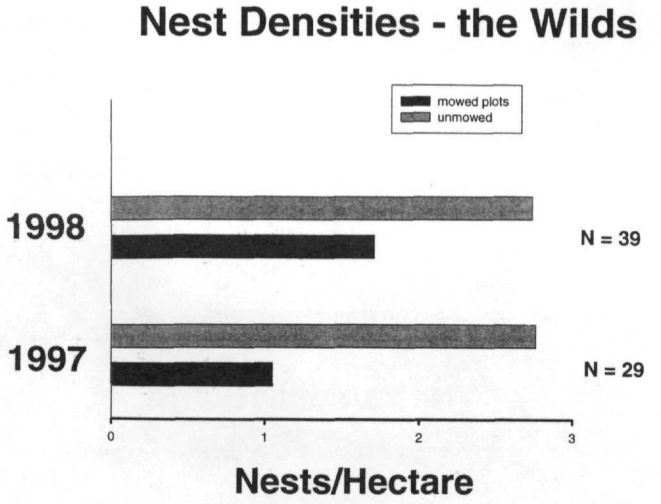

FIGURE 4. Mean density of nests of all grassland bird species combined on five mowed and five unmowed reclaimed stripmine plots in 1997 and 1998.

versus after 1 June (0 before, 7 after; $X^2 = 4.04$, df = 1, $P < 0.05$); however, the difference was not significant in 1998 (18 before, 8 after on unmowed; 7 before, 6 after on mowed; $X^2 = 0.35$, df = 1, $P > 0.05$) or when both years were combined (29 before, 18 after on unmowed; 7 before, 13 after on mowed; $X^2 = 3.02$, df = 1, $P = 0.08$).

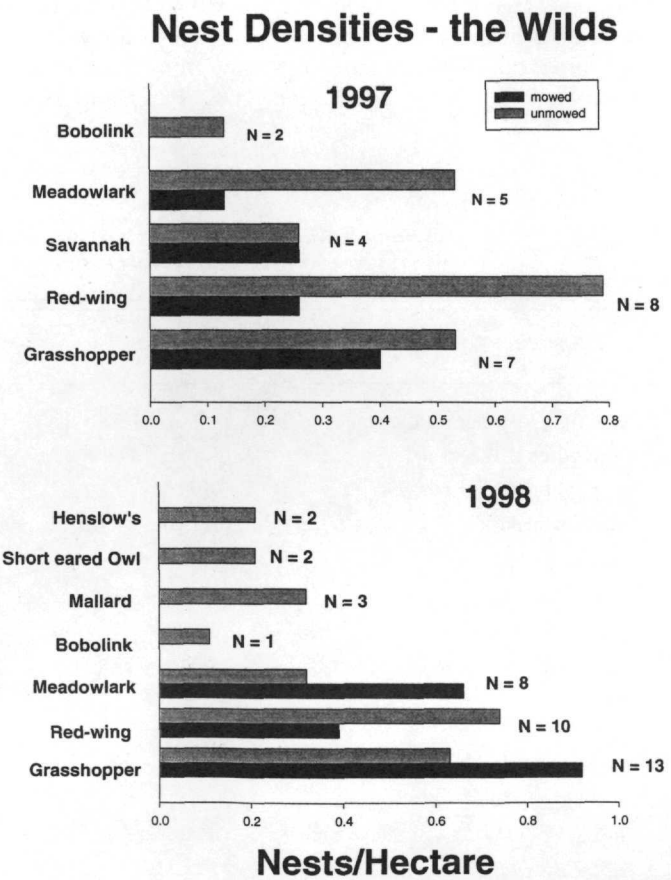

FIGURE 5. Mean density of grassland bird nests on five mowed and five unmowed reclaimed stripmine plots in 1997 and 1998.

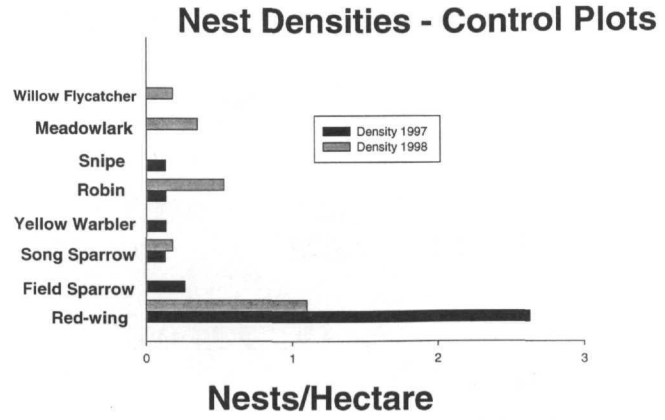

FIGURE 6. Mean nest density of grassland birds on five control plots in 1997 and 1998.

DISCUSSION

Several grassland bird species, including bobolinks, Henslow's sparrows, and savannah sparrows, considered to be area sensitive, were common at the Wilds. Area-sensitive grassland birds are most commonly found on tracks of land >50 ha, and are the most vulnerable to habitat fragmentation (Herkert 1991; Swanson 1996; Walk and Warner 1999). Grasshopper sparrows, eastern meadowlarks, and red-winged blackbirds, which are less vulnerable to habitat fragmentation, were also common on this reclaimed stripmine. These data generally support the findings of others which suggest that reclaimed stripmines frequently provide large (>50 ha), contiguous patches of anthropogenic grasslands that attract grassland birds that might otherwise be uncommon or absent in the area (see Wray and others 1982; Peterjohn 1989; Peterjohn and Rice 1991; Vickery and others 1994; Swanson 1996; Bajema and others 2001).

During this study I found four short-eared owl nests and three confirmed nesting pairs of short-eared owls, all but one of which were on the unmowed, reclaimed plots (one of the pairs was located off the study plots in an unmowed area). Holt and Leasure (1993) reported that short-eared owls nest only in the extreme northern counties of Ohio. Peterjohn (1989) and Peterjohn and Rice (1991) reported that breeding short-eared owls in Ohio, particularly in the unglaciated portion of the state, are rare, and although there have been occasional reports of summering owls on reclaimed stripmines in southeastern Ohio, their breeding status remained uncertain. Peterjohn and Rice (1991) also suggested that some owls are likely overlooked in certain areas such as on extensive reclaimed stripmines. Thus, although it appears that short-eared owls have been occasionally nesting on reclaimed mines in southeastern Ohio during the past few decades, my findings represent some of the few, if not the only, confirmed short-eared owl nests in this portion of the state in several decades.

Species composition on the control sites included many of the same grassland birds found on the reclaimed stripmine, (for example, bobolinks, eastern meadowlarks, Henslow's and grasshopper sparrows), but in fewer numbers and generally confined to the hayfields. Since each hayfield was mowed in early June of both years, it is likely that these populations were far less successful than those at the Wilds. Not surprisingly, red-winged blackbirds were the most abundant species on the control plots as well as one of the most abundant species on the reclaimed stripmine, perhaps reflective of their proclivity to nest in a wide variety of

TABLE 1

Results of Mayfield analyses of reproductive success on grassland birds on the reclaimed stripmine and on the control plots in 1997, 1998, and in both years combined.

Species	1997	1998	Combined
Reclaimed Stripmine Plots			
Red-winged Blackbird	0.22 (n = 8)	0.42 (n = 10)	0.30 (n = 18)
Grasshopper Sparrow	0.49 (n = 6)	0.43 (n = 13)	0.46 (n = 19)
E. Meadowlark	0.17 (n = 5)	0.34 (n = 8)	0.30 (n = 13)
Savannah Sparrow	0.51 (n = 4)	———	0.51 (n = 4)
Bobolink	0.89 (n = 2)	1.00 (n = 1)	0.93 (n = 3)
Short-eared Owl	———	0.59 (n = 3)	0.59 (n = 3)
Henslow's Sparrow	1.00 (n = 1)	0.47 (n = 2)	0.64 (n = 3)
Control Plots			
Red-winged Blackbird	0.23 (n = 20)	0.38 (n = 6)	0.34 (n = 26)
Field Sparrow	0.83 (n = 2)	———	0.83 (n = 2)
Robin	———	0.36 (n = 4)	0.36 (n = 4)
E. Meadowlark	———	0.37 (n = 2)	0.37 (n = 2)
Song Sparrow			0.32 (n = 2)

habitats (see Yasukawa and Searcy 1995).

In this study, I found differences in species composition, bird abundances, nest densities, and the timing of nesting of birds on the mowed versus unmowed plots. The small sample size of nests in this study precludes me from making broad-based inferences regarding the nesting success of these grassland species. However, it did appear that short-eared owls, bobolinks, and Henslow's sparrows avoided nesting on the mowed plots, at least early in the season, although some bobolinks and Henslow's sparrows were detected along transects in the mowed plots later in the season. Although bobolinks to some extent favor new vegetative growth for nesting and foraging (Wittenberger 1978), the period of time between mowing and the onset of nesting in this study apparently did not allow enough regrowth to provide adequate bobolink nesting habitat. My findings suggest that early-season mowing was detrimental to Henslow's sparrows; future studies might also address the effects of late-season mowing on this species since mowing will likely be considered as a successional management tool at the Wilds in the future.

With the possible exception of eastern meadowlarks, the two grassland bird species in this study that seemed to be unaffected by early-season mowing were savannah and grasshopper sparrows. Both species nested about equally on mowed and unmowed plots and neither species seemed to require much cover for nest concealment. These findings are fairly consistent with the literature. Herkert (1991) and Sample (1989) found that savannah sparrows were most abundant in fields that had been recently mowed (prior to nesting) and generally avoided habitats characterized by tall, dense vegetation. Sample (1989) reported that savannah sparrows seemed to prefer managed or recently disturbed areas that possessed shorter, sparser vegetation. Like savannah sparrows, grasshopper sparrows also prefer sparse, grassy vegetation for nesting (Cody 1968; Weins 1969, 1973), and Herkert (1991, 1994b) found that the nesting density of grasshopper sparrows was twice as high on areas mowed during the four months prior to nesting than on unmowed areas.

Perhaps one influence that early season mowing had on the breeding birds in this study was that it seemed to force a delay in the initiation of nesting compared to birds on the unmowed plots. Typically, savannah and grasshopper sparrows, as well as eastern meadowlarks and red-winged blackbirds, those species that nested on the mowed plots, are capable of producing two or more successful broods in a single season (see Wheelwright and Rising 1993; Lanyon 1995; Vickery 1996). It is possible that the early-season mowing in this study reduced the chances of these species producing multiple broods on the mowed plots as a result of this delay.

The predation rate for all plots on the reclaimed stripmine for both years was 41%, which was comparable to what Wray and others (1982) reported for grassland birds on a reclaimed stripmine in West Virginia (43%). Predation rates for all species were about the same on the mowed, unmowed, and control plots in 1997, and only slightly higher on the mowed and control plots compared to the unmowed plots in 1998. Apparently early mowing did not significantly enhance the rates at which predators located nests. Wray and others (1982) concluded that even though reclaimed surface mines in West Virginia provided adequate nesting habitat for a variety of grassland birds, low reproductive success and high predation rates suggest that these anthropogenic grasslands were acting as a population sink. The reproductive success of grasshopper sparrows in this study was much higher than what Wray and others (1982) reported for this species during the last two years of their study (46% versus 8%). Eastern meadowlark and red-winged blackbird reproductive success in this study was higher than what Kershner and Bollinger (1996) reported for these species nesting on airport grasslands (30% and 30%, respectively, in this study, versus 14% and 6%). These findings should be interpreted cautiously, however, because of my small nest sample size (n = 69 for all species during both years combined). It appears though that this reclaimed stripmine is supporting sustainable populations of grasshopper and savannah sparrows, as well as red-winged blackbirds, eastern meadowlarks, bobolinks, and Henslow's sparrows. A study currently underway on the same plots examining grassland bird nest-site fidelity with color-banded individuals, seems to support this conclusion.

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